SUPPORT FOR SHUTTLE ENVIRONMENTAL PROGRAM AND PROJECTS

Quarterly Report # 1
February 11, 2005

NASA Contract: NAS10-03029
Task Order No. 7

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Executive Summary

International Trade Bridge Inc. (ITB) supported the Propulsion Systems Engineering and Integration (PSE&I) Office in implementing the Shuttle Environmental Assurance (SEA) Initiative and other environmental projects. This work consisted of environmental engineering, technical, business, interface, integration, management and administrative efforts required to develop, plan and integrate environmental activities for NASA's Space Shuttle Program (SSP) and for other related Agency wide environmental programs supported by the SSP PSE&I Office. This quarterly report covers the period November 1, 2004 through January 31, 2005.

Major accomplishments during this period included:

- Provided input to new SSP risk matrix and associated documentation
- Updated risk assessments for SEA issues
- Supported SEA team collaborative study efforts, including the collection of usage data and the assessment of environmental health and safety impacts associated with alternate materials
- Prepared draft collaborative study report
- Prepared final SEA 2004 Mid-year Status Report
- Supported SEA and PSE&I work on the Shuttle Transition Team and Strategic Planning Efforts

Introduction

The Propulsion Systems Engineering and Integration (PSE&I) Office at Marshall Space Flight Center (MSFC) leads the NASA Space Shuttle Program (SSP) Shuttle Environmental Assurance Initiative (SEA). The goals of SEA are to reduce material obsolescence risks and minimize duplication in alternative material qualification among the NASA Centers and contractors. SEA works to proactively identify regulatory and other drivers for materials replacement, provides a forum for data sharing and communication to management, and reduces duplication of effort among the shuttle elements through establishment of effective management and communication tools. SEA also facilitates collaborative projects and needs across all STS program elements, acquisition, operation and sustainment processes owners, and NASA Government activities supporting manufacturing and maintenance processes. In addition, PSE&I provides environmental input/review/direction/reporting to the SSP environmental activities such as audits, regulatory activities, sustainability, restoration, planning, and SSP transition.

PSE&I is working with the NASA Acquisition Pollution Prevention (AP2) Program Office at Kennedy Space Center (KSC) in the proactive identification and integration of pollution prevention, systems safety, and risk assessments for related NASA programs and initiatives.

International Trade Bridge Inc. (ITB) is supporting the PSE&I Office in implementing the SEA Initiative and in other environmental activities. This report summarizes ITB core support for this work. This work consists of environmental engineering, technical, business, interface, integration, management and administrative efforts required to develop, plan and integrate environmental activities for NASA's SSP and for other related Agency wide environmental programs supported by NASA's Propulsion Systems Engineering and Integration Office.

Ms. Anne Meinhold is accomplishing the ITB, Inc. support to the SEA at Marshall Space Flight Center (MSFC) through Task Order 7, which began on November 1, 2004. This is the first quarterly report for this task order and covers the period November 1, 2004 through January 31, 2005. The Statement of Work for Task Order 7 is attached as Appendix A.

Accomplishments this Reporting Period

- **Technical Evaluations**
    - Completed review of materials, environmental, range safety and risk assessment Change Requests (CRs) and Program Requirements Control Board Directives (PRCBD) and status reports
    - Provided comments on and tracked PRCBD and CR actions addressing Columbia Accident Investigation Board (CAIB) Observations on public risk associated with Shuttle flight
    - Provided input to new SSP risk scorecard and associated documentation

- **R&D of Materials Replacement Technology and Processes**
    - Tracked JG-PP lead free solder project
    - Applied SSP updated risk scorecard to SEA issues
    - Managed SEA team collaborative study efforts
    - Developed review draft of collaborative study reports
- **SEA Interface Management and Integration Support**
    - Prepared Integrated Logistics Panel (ILP) briefing November 2004
    - Prepared list of DoD Interfaces
    - Provided input to Shuttle Transition Panel Report and Planning
    - Provided input to initial work on Shuttle Environmental Transition Plan
- **Administrative**
    - Prepared Final SEA 2004 Mid-year Status Report

Cost Summary for This Reporting Period

25 % of funding expended as of January 31, 2004

Status and Progress

Technical Evaluations

Range Safety Panel

ITB supported PSE&I in tracking work by the Range Safety Panel related to range safety issues. Issues of particular concern include a series of actions and PRCB briefings related to range safety issues identified as findings and observations by the Columbia Accident Investigation Board (CAIB) report.

The Mission Operations Directorate (MOD) at Johnson Space Center (JSC) is responsible for addressing the actions that came out of the CAIB report addressing debris risk, estimating risks to the public, and evaluating alternate landing sites (EDW: Edwards Air Force Base; NOR: Northrup strip at White Sands) to reduce risks associated with entry and landing. This work was statused at the PRCB on December 2, 2004 (S064026).

The debris from Columbia is being measured and cataloged in a joint NASA/Federal Aviation Administration (FAA)/Air Force study. These data will probably not be of much use to Shuttle, but other NASA programs and federal agencies are interested in this work. Shuttle does not plan to fund this work.

MOD estimates that the maximum individual risk during a shuttle entry is about 1.3×10^{-7} per flight along the final approach to the runway. The risk to the population (E_c, number of expected casualties) varies with the trajectory and the landing site. The collective risk per shuttle flight is about 1000 times greater than the risk for a general or commercial aviation flight.

	Mean E_c
KSC	1.02×10^{-3}
NOR	2.80×10^{-4}
EDW	2.0×10^{-3}

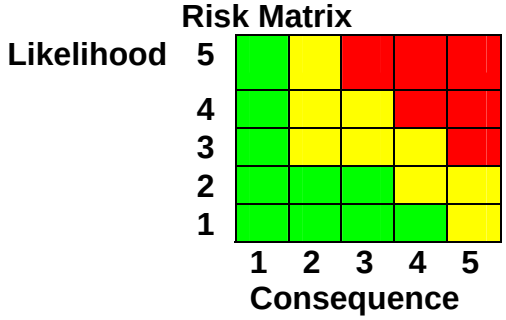
MOD is developing flight rules that include public risks as a consideration in decision making during re-entry. The primary assumption is that risks associated with landing at KSC are acceptable, and that KSC will remain the prime landing site. When Edwards or Northrup are required, the entry approach will be selected to avoid opportunities with risk greater than the KSC opportunity with the highest risk. This will be done to the extent possible while managing other critical considerations such as the weather, crew health, etc.

The Headquarters Office of Safety and Mission Assurance is working on a Range Safety Policy that should be available for review this spring. This guidance will require that new vehicles meet the current Air Force public risk level of 30×10^{-6} expected casualties per entry. Shuttle will be required to develop a range safety plan, but will not be held to this requirement.

SSP Risk Scorecard

Risks to the SSP associated with the loss of a material, or environmental, health and safety concerns are assessed in terms of both probability and impact. The risk matrix plots the likelihood that an issue will affect the SSP – from “Highly Unlikely” (1) to “Very Likely” (5) – against the consequence of the issue if it does occur – from “minor or first aid injury” or “temporary usage loss of non-flight critical asset “ (1) to “death” or “ inability to support further Shuttle Flight Operations “ (5). Issues that fall in the red zone are those that present high risks to the program, those in yellow zone present medium risks, and those in the green zone present low risks.

The SSP is implementing a standard risk assessment and reporting process. This process uses the SSP risk matrix and a database/reporting software (SIRMA: Shuttle Integrated Risk Management Application) to assess SSP wide issues and report high program risks directly to Level 2 management.



The SSP scorecard was modified to better capture program risks, and to support a common approach to Program risk assessment between Shuttle and International Space Station. ITB commented on CRs associated with this new scorecard, and provided input to the scorecard in identifying environmental safety and health and safety compliance scores. The new scorecard is attached in Appendix B. The updated section to the NTS 7700 documentation for the scorecard, which includes ITB's input to the environmental and compliance sections, is attached in Appendix C.

R&D of SSP Materials Replacement Technology and Processes

SEA Issues

The SEA team is currently working 17 issues. Three of these issues are being addressed in collaborative studies (hexavalent chromium in primers, hexavalent chromium in conversion coatings, cadmium in plating applications) and ITB has lead responsibility for facilitating this work. The current status of these issues is summarized in the Final Draft Mid-Year Status Report (Appendix D).

Lead Free Solder

ITB has major responsibility in tracking the lead-free solder issue for SEA. SEA continues to track the potential impact of the industry trend toward lead-free solders. SEA is participating in the JG-PP project to evaluate lead-free solders and is being supported by the MSFC Avionics Department. The AP2 Office is managing this project and periodically briefs the SEA Team on its status. The MSFC Avionics support team is working with NASA Headquarters to address this issue for the Agency.

Some vendors are creating two lines of components, one containing lead for NASA and military applications and one using lead free solders. The impact of lead free solder use in flight hardware is unknown, but there have been cases of satellites being affected by a lead free component. There is a risk that SSP will receive components with lead free solder that does not meet specifications and could affect performance of flight hardware.

The current mitigation plan is to evaluate potential risks, notify logistics organizations, remind vendors that lead free solders are not approved for use and that procurement organizations must be notified of any change. Because some vendors are creating parallel lines of components, critical parts will be tested to ensure that specifications are met. SEA notified the Integrated Logistics Panel and SSP Projects of this issue. Orbiter and KSC Logistics have sent memos to vendors. Some elements have begun testing components.

SEA Issue Management and Risk Assessment

Risks associated with SEA issues are assessed using the Space Shuttle Program risk matrix. ITB updated the risk scores for the SEA issues (Appendix E) and entered the data into the SIRMA data base. SEA issues are labeled as "concerns" in the SIRMA data base, which prevents them from being accessed by other SSP organizations or directly elevated to Level 2 management. The new risk scores are shown in Table 1. Changes from the last report to management are outlined in bold.

Table 1. Baseline and Current Risk Assessment for SEA Issues*

ISSUE	Risk (Likelihood x Consequence)			
	BASELINE		CURRENT	
	Technical	Programmatic	Technical	Programmatic
HCFC 141b Blowing Agent	HIGH (5 x 4)	HIGH (5 x 5)	MEDIUM (2 x 4)	MEDIUM (2 x 5)
1,1,1 Trichloroethane Elimination (Orbiter use)	HIGH (5 x 4)	HIGH (5 x 5)	MEDIUM (2 x 4)	MEDIUM (2 x 5)
1,1,1 Trichloroethane Elimination (RSRM use)	HIGH (5 x 4)	HIGH (5 x 5)	MEDIUM (2 x 4)	MEDIUM (2 x 5)
Hexavalent Chromium Replacement in Primers	MEDIUM (3 x 3)	MEDIUM (3 x 4)	MEDIUM (3 x 3)	MEDIUM (3 x 4)
Hexavalent Chromium Replacement in Conversion Coatings	MEDIUM (3 x 3)	MEDIUM (3 x 4)	MEDIUM (3 x 3)	MEDIUM (3 x 4)
Cadmium Replacement in Plating Applications	MEDIUM (3 x 3)	MEDIUM (3 x 4)	MEDIUM (3 x 3)	MEDIUM (3 x 4)
Chemical Paint Stripper Alternatives	MEDIUM (3 x 3)	MEDIUM (3 x 2)	LOW (2 x 3)	LOW (2 x 2)
Alternate Dry-Film Lubricant	MEDIUM (3 x 3)	MEDIUM (3 x 3)	LOW (2 x 3)	LOW (2 x 3)
High Volatile Organic Carbon Coatings	MEDIUM (3 x 3)	MEDIUM (3 x 3)	MEDIUM (3 x 3) (was LOW)	MEDIUM (3 x 3)
Hypalon Paint	LOW (2 x 2) (was MEDIUM)	LOW (2 x 2)	LOW (2 x 2)	LOW (2 x 2)
Lead-Free Electronics	MEDIUM (3 x 3)	MEDIUM (3 x 3)	MEDIUM (3 x 3)	MEDIUM (3 x 3)
Hexavalent Chromium in Alkaline Cleaners	MEDIUM (3 x 3) (was LOW)	MEDIUM (3 x 3)	LOW (2 x 3)	LOW (2 x 3)
Hazardous Air Pollutant inks	LOW (2 x 3)	LOW (2 x 2)	LOW (2 x 3)	LOW (2 x 2)
Methyl Ethyl Ketone Replacement	LOW (2 x 3)	LOW (2 x 2)	LOW (2 x 3)	LOW (2 x 2)
Cleaning and Verification Solvents	LOW (2 x 3)	LOW (2 x 2)	LOW (2 x 3)	LOW (2 x 2)
Perfluoroalkyl Sulfonates	MEDIUM (5 x 2) (was LOW)	MEDIUM (5 x 2)	LOW (1 x 2)	LOW (1 x 2)
Brominated Flame Retardants	TBD	TBD	TBD	TBD

* Baseline risk is risk without mitigation

Collaborative Studies

The SEA Team is working on a scoping study to determine the potential benefits of future, multi-element collaborative testing and replacement efforts for hexavalent chromium in epoxy primers, hexavalent chromium in conversion coatings, and cadmium in plating applications. In this study SEA: 1) makes recommendations to the Program concerning the replacement of these materials based on results of a risk assessment; (2) identifies performance requirements for replacement materials; (3) summarizes relevant work done by the Department of Defense; (4) identifies potential replacement materials and; (5) presents a proposed mitigation plan and test plan elements. SEA is currently drafting technical reports and recommendations for this scoping study. The SEA Team is planning to develop briefings and a request for funds to support initial collaborative test plans that will go to the Program in early 2005.

SEA initially planned to perform a study to assess the benefits of multi-element collaboration in addressing the replacement of HCFC 141b in TPS. This work has been put on hold and will depend on return-to-flight activities and priorities.

ITB is supporting SEA in managing and facilitating these collaborative studies. ITB is responsible for the risk assessment and environmental health and safety screening of currently used and alternative materials. The ITB staff in the AP2 Office is working closely with SEA in identifying requirements for replacement materials as well as identifying and summarizing work done by other agencies. Patti Lewis (ITB/AP2) provided detailed summaries of work being done by other agencies in support of these studies. ITB has also worked to collect usage data for chromated primers, chromated conversion coatings and cadmium plated components to support a risk assessment and environmental health and safety analysis. ITB prepared the draft of the collaborative study report, and plans to finalize a draft for review in March 2005 with input from Lockheed Martin, Boeing and the AP2 Office.

SEA Interface Management and Integration Support

ITB is working to develop interfaces with other NASA organizations and agencies to leverage information, aid in technology transfer, and optimize resources for the SSP and other agencies. Ms. Meinhold continued to work with the AP2 Office to share information generated by SEA and to pass on Pollution Prevention requests from the Clean Air Act Working Group and other NASA organizations. The NASA AP2 Office is providing support to the SEA in its implementation of the Collaborative Studies work and has been providing useful information and contacts to the group. ITB also continues to engage the MSFC Environmental Office and the Engineering Directorate in SEA activities and the SEA collaborative studies. ITB is also working to engage the Air Force Space Command at Peterson Air Force Base in working with SEA. Mr. Dean Dunn with Air Force Space Command is interested in collaborating with NASA and Shuttle on mitigation projects, and plans to attend SEA teleconferences and face to face meetings.

ITB prepared a briefing for the Shuttle Integrated Logistics Panel (November 2004; Appendix F). ITB also prepared a list of DoD interfaces to satisfy a request to Shuttle from MSFC (Appendix G).

The SSP is beginning to plan for the eventual decommissioning of the Shuttle. This effort will require an assessment of personnel, assets and environmental issues. ITB supported SEA and PSE&I participation in Transition Panel and Strategic Planning meetings, and provided input to Transition Panel briefings and Reports. ITB also supported SEA and PSE&I in the initial planning for a Shuttle Environmental Transition Plan.

Administrative Support

General

ITB provided general administrative support to PSE&I and SEA. ITB edited minutes, developed agendas, and updated schedules and action lists.

Mid-year Status Report

ITB drafted the final SEA 2004 Mid-year status report (Appendix D). This draft was completed on January 26 and sent out to the SEA Team for final review. This status report was held until after the first of the year to allow re-scoring of the issues using the new SSP risk scorecard. ITB will address comments by the SEA team and complete the final report.

Technical Products and Deliverables

Technical reports and deliverables completed this quarter include:

- Updated Risk Scorecard (Appendix B)
- Risk Scorecard Guidance (Appendix C)
- Final Draft Mid Year Status Report (Appendix D)
- Updated SEA Risks (Appendix E)
- Review Draft Collaborative Study
- ILP Briefing (Appendix F)
- DoD Interfaces List (Appendix G)